

What is claimed is:

1. A reactor for hydrotreating, which comprises at least four catalyst layers packed respectively with hydrotreating catalysts satisfying the relationship represented by the following formulae:

$$S_n \leq S_{n+1} \quad (1)$$

$$1.15V_n \geq V_{n+1} \quad (2)$$

wherein S represents the surface area per cubic meter of each hydrotreating catalyst; V represents the pore volume per cubic meter of catalyst; and wherein n is a natural number representing the order of each catalyst layer.

2. The reactor according to claim 1, wherein the reactor comprises 4 to 20 catalyst layers.

3. The reactor according to claim 1, wherein the reactor comprises 5 to 15 catalyst layers.

4. The reactor according to claim 1, wherein an amount of the catalyst packed into each catalyst layer is 3 to 70 % by volume based on the total amount of the catalysts packed into the reactor.

5. The reactor according to claim 1, wherein the hydrotreating catalysts contain a hydrogenation activating metal and a carrier of a porous inorganic oxide supporting the metal.

6. The reactor according to claim 5, wherein the hydrogenation activating metal is at least one

member selected from the group consisting of group IB metals, group VB metals, group VIB metals and group VIII metals.

5 7. The reactor according to claim 5, wherein the hydrogenation activating metal is at least one member selected from the group consisting of cobalt, molybdenum, nickel and tungsten.

10 8. The reactor according to claim 5, wherein the porous inorganic oxide is at least one member selected from the group consisting of alumina, silica, titania, zirconia, magnesia, alumina-silica, alumina-boria, alumina-titania, alumina-zirconia, alumina-magnesia, alumina-silica-zirconia, alumina-silica-titania, zeolites, sepiolite and montmorillonite.

15 9. The reactor according to claim 5, wherein an amount of the hydrogenation activating metal supported is 1 to 40 % by mass based on the total amount of the catalyst.

20 10. A process for producing an ultralow sulfur heavy oil, which comprises using a reactor for hydrotreating which contains at least four catalyst layers packed respectively with hydrotreating catalysts satisfying the relationship represented by the following formulae:

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$$S_n \leq S_{n+1} \quad (1)$$

$$1.15V_n \geq V_{n+1} \quad (2)$$

wherein S represents the surface area per cubic meter of each hydrotreating catalyst; V represents the pore volume per cubic meter of the catalyst; and wherein n is a natural number

5 representing the order of each catalyst layer, and passing a heavy oil through the first to the last catalyst layers successively to thereby bring the heavy oil into contact with hydrogen gas under hydrogenation conditions in each catalyst layer.

10 11. The process according to claim 10, wherein the reactor comprises 4 to 20 catalyst layers.

12. The process according to claim 10, wherein the hydrogenation conditions include the reaction temperatures of 300 to 480 °C.

15 13. The process according to claim 10, wherein the partial pressures of hydrogen at the inlet of the reactor range from 1.0 to 25.0 MPa.

14. The process according to claim 10, wherein the hydrogen/oil ratios at the inlet of the
20 reactor range from 100 to 2000 Nm³/m³.